WHAT IS CLAIMED IS:

1. An air-fuel ratio computing apparatus, comprising:

a linear air-fuel ratio sensor provided to an exhaust pipe of an engine, for measuring an air-fuel ratio of exhaust gas emitted from the engine; and

an electronic control unit for repeatedly performing filter processing on the air-fuel ratio measured by the linear air-fuel ratio sensor, using a formula

$$Vf(n) = (1-G) \times Vf(n-1) + G \times V(n),$$

where V(n) represents a voltage value corresponding to the air-fuel ratio measured by the linear air-fuel ratio sensor,

Vf(n-1) represents a previous computed value from the filter processing,

$G(0 \leq G \leq 1)$ represents a filter gain expressing a computational ratio of V(n) and Vf(n-1), and

Vf(n) represents a current computed value of the filter processing,

wherein, in a case where a temperature of the linear air-fuel ratio sensor is below a predetermined temperature, the electronic control unit cuts off a pump current to the linear air-fuel ratio sensor, performs the filter processing with the filter gain G set to a first predetermined value, and transforms a computed value from the filter processing into a theoretical air-fuel ratio voltage; and in a case where the temperature of the linear air-fuel ratio

sensor rises to or above the predetermined temperature, the electronic control unit performs the filter processing with the filter gain G set to a second predetermined value that is smaller than the first predetermined value, and computes an air-fuel ratio from the difference between a computed value from the filter processing and the theoretical air-fuel ratio voltage.

2. An air-fuel ratio computing apparatus according to claim 1, wherein the electronic control unit 1 comprises:

an air-fuel ratio detection circuit for detecting the temperature of the linear air-fuel ratio sensor, and detecting an air-fuel ratio electric signal from the linear air-fuel ratio sensor;

a current/voltage conversion circuit for transforming the air-fuel ratio electric signal detected by the air-fuel ratio detection circuit into a voltage value;

a microcomputer that, in a case where the temperature of the linear air-fuel ratio sensor detected by the air-fuel ratio detection circuit is below the predetermined value, outputs a pump current cut-off command to cut off the pump current to the linear air-fuel ratio sensor, performs the filter processing with the filter gain G set to the first predetermined value, and transforms the computed value from the filter processing into the theoretical air-fuel ratio voltage; and in a case where the temperature of the linear air-fuel ratio sensor detected by the air-fuel ratio detection circuit rises

to or above the predetermined value, performs the filter processing with the filter gain G set to the second predetermined value that is smaller than the first predetermined value, and computes the air-fuel ratio from the difference between the computed value from the filter processing and the theoretical air-fuel ratio voltage; and

a pump current cut-off circuit for cutting off the pump current to the linear air-fuel ratio sensor in response to the pump current cut-off command.

3. An air-fuel ratio computing apparatus according to claim 2, wherein when the microcomputer transforms the computed value from filter processing when the filter gain G was set to the first predetermined value into the theoretical air-fuel ratio voltage, the microcomputer calibrates toward the side with the smaller air-fuel ratio error.